

after the march. The calculation of elimination by the skin was made by careful analysis of the underclothing. The average amount was found to be 284 mg. per litre of perspiration, and as the perspiration increased the proportion of nitrogen eliminated diminished. Thus 2069 grms. of perspiration contained 0.308 per cent. of nitrogen, while 3447 grms. contained only 0.243 per cent. The number of observations on this point was few, and the results suggest the need of further investigation.

In estimating the respiratory changes, the authors made use of the "*tret-werk*," a rolling platform worked by machinery so as to move backwards at the same rate as the individual walking upon it moves forwards. In this manner he remains constantly at the spot where the apparatus for measuring the respired air is fixed. The two students marched on this "*tret-werk*" for six to eight minutes immediately after each march, and for eight to ten minutes during periods of rest, with and without the knapsack. The influence of the marches on the respiratory changes was determined by the "respiratory quotient," *i.e.* the quotient derived by dividing the volume of CO<sub>2</sub> expired by the volume of O inspired. This quotient is equal to unity in the case of herbivorous animals, who obtain their carbon from carbohydrates only and not from hydrocarbons. In carnivorous animals the necessity of using some of the oxygen for the oxidation of the hydrogen in the hydrocarbons, which they consume, diminishes the volume of CO<sub>2</sub> expired in proportion to the oxygen inspired, and the quotient in their case is consequently expressed by a fraction of unity. The authors make use of this fact and show that the "respiratory quotient" is a constantly diminishing fraction after heavy marches. In other words, the carbohydrates are very quickly used up, leaving the fats only as energy-producing material. They conclude from this that, in continuous heavy marching, the carbohydrates consumed in the rations are not sufficient to replace the waste, and that a day's rest is required after every three days' marching to enable the body to recover its normal power.

There are many other points in this volume that are suggestive and of practical importance in military training and in military operations, and it must be regarded as one of the most important works that have been published with reference to several questions that arise in connection with military hygiene. The German military authorities, at any rate, have accepted the conclusions as authoritative, and the regulations bearing upon marching and physical training in Germany are evidently inspired by them.

W. G. M.

#### LIVES OF THE HUNTED.

*The Lives of the Hunted.* By Ernest Seton-Thompson. Pp. 360. (London: Nutt, 1901.) Price 6s. net.

"LIVES OF THE HUNTED" is practically a second volume to the first of three books noticed in a general review of Mr. Seton-Thompson's work lately published in NATURE (p. 25), "Wild Animals I have Known." When a book has earned a well-deserved success, the temptation to the author to write another on

the same lines is strong. But sequels of the kind are seldom as good as the originals, and this is no exception to the rule.

Mr. Thompson is so well up in his subjects that nothing that comes from his pen or pencil can be without interest. The full-page illustrations—more particularly those of the bears in the Yellowstone Park and the big-horn ram facing the wolves—are excellent; but, with some exceptions, neither the letterpress nor the marginal sketches are quite on the level either of the book named above or of the "Biography of a Grizzly."

Unfortunately, too, the little pitted speck noticeable in his earlier writings—more especially in "The Trail of the Sandhill Stag"—a tendency to a rather sickly sentimentality, has grown to disfiguring proportions, and in his last production is a serious blemish.

"The preservation of our wild creatures," to which the book is dedicated, is a worthy object. But it is doubtful whether it is likely to be substantially helped by suggestions, if not actual arguments, which, in spite of Mr. Thompson's assurance that he does "not champion any theory of diet," can only, if pushed to their logical conclusions, mean that mankind is in duty bound to give up eating meat and turn vegetarian. The sneer at "the Saxon understreak of brutish grit, of senseless, pig-dogged pertinacity," which made the old huntsman Scottie stick to the trail of the great ram until the coveted head and horns were his—the race-quality, by the bye, which has helped more, probably, than any other to raise the United States as well as England to the positions they hold among the nations—may appeal, perhaps, to some of his readers, but to others less emotional it may seem a little silly.

"Wolfish human brute" is rather a "brutal" summing-up of the character of the plucky old stalker, whose actual name is given, to come from the pen of a writer who, according to his own account, was not, in trapping days, foolishly over scrupulous.

But when he leaves "gush" and sentiment behind him, and, warming to his work, writes in the bright, unpretentious style which is more natural to him of the things he has seen and known, Mr. Thompson is well worth reading.

"Johnny Bear," the third story in the collection, is a simply-written and charming description of the ways of the bears he studied closely in the Yellowstone Park, and even more delightful, perhaps, is the account he gives of the home and habits of the fairy-like kangaroo rat,

"the loveliest, daintiest fawn-brown little creature ever seen in fur," with "large beautiful eyes . . . innocent orbs of liquid brown; ears like the thinnest shells of the sea, showing the pink veins . . .; hands the tiniest of the tiny, pinky-white and rounded and dimpled like a baby's."

Sentiment notwithstanding, Mr. Thompson dug out and explored, and in the margin gives a plan of the little creatures' underground establishment, which was safely protected from the attacks of coyotes and other miscreants by the spiked leaves of an overshadowing "Spanish bayonette" bush. It is engineered on much the same general lines as the breeding nest of a mole, with

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the addition of granaries for dried seeds—the different sorts kept separately—and with more blind passages. In place of the leaves with which a mole fills its more roughly constructed inner sanctuary, the kangaroo rat's nest was lined with "a thick felting of fine grass and weed silk, and, inside all, a lining of softest feathers." "I think," he writes, "that every gay little bird on the plains must have contributed one of its finest feathers to that nest."

Among the best passages in the book are those in which Mr. Thompson in his first chapter reads the records of the old ram's long life in the gravings of his horns. The deep dent tells of the early battle in which he won his spurs. The two dark-coloured, wrinkled rings close together lower down are reminders of the years of starvation and the sickness which carried off the weaker members of the flock, and the bolder ridges wide apart recall the prosperous years that followed.

He has much to tell that is worth learning, and, left to himself, can tell it excellently. It will be a misfortune to many lovers of natural history besides himself if Mr. Thompson is beguiled into sacrificing himself on the shrine of the admirers who, as he tells in his preface, "bitterly denounced" him for confessing that in unregenerate days he was not above killing a dangerous wolf when he could.

T. D. P.

### CUBIC AND QUARTIC CURVES.

*An Elementary Treatise on Cubic and Quartic Curves.*

By A. B. Basset, F.R.S. Pp. xvi + 255. (Cambridge: Deighton, Bell and Co., 1901.) Price 10s. 6d.

NOW that Salmon's "Higher Plane Curves" is out of print there is undoubtedly room for a good book on the subject. The purpose of such a book would be to give students who had read conic sections and the infinitesimal calculus a good knowledge of the main lines on which the theory of curves has been developed. The bookwork would contain discussions of the chief theorems; those of less importance would be given as examples, and would furnish the student with abundant matter for independent thought. The proofs given would, so far as possible, be models of rigour and elegance, and in the rare cases where rigour was sacrificed for the sake of simplicity this would be confessed. The book before us has not been written altogether on these lines. There are no examples, and a great deal of space is taken up in proofs of the properties stated that could, in our opinion, have been put to better use; moreover, the proofs given are not always satisfactory, and even the theorems themselves are sometimes wrongly stated.

After two introductory chapters, chapter iii. deals with tangential coordinates, reciprocal polars and foci, chapter iv. with Plücker's equations. Then we have a chapter on "cubic curves" (pp. 56-73) and another on "special cubics" (pp. 74-96). The special curves discussed are circular cubics, and in particular some that are the inverses of conics, the semicubical and cubical parabolas, the folium of Descartes, the witch of Agnesi. Chapters viii., ix., x. are respectively on "quartic curves" (pp. 101-132), "bicircular quartics" (pp. 133-161), "special quartics" (pp. 162-204). Non-singular, or, as the author prefers to call them, anautotomic quartics,

receive attention for three pages only (115, 117, 122). The special quartics discussed are the cassinian, the lemniscates of Bernoulli and Geron, cartesians, limaçons, the cardioid and the conchoid of Nicomedes. Chapter xi. treats of "miscellaneous curves," roulettes, the evolute of an ellipse, the involute of a circle, the catenary, tractory, elastica and spirals. Chapter xii. is on projection. Some useful references are given in footnotes.

The author has not found space for any general discussion of the forms of cubic and quartic curves, or of the expressions for the coordinates of a variable point on a curve in terms of a parameter, even when the curve is unicursal. The theory of residuation is not mentioned. The following are some of the matters of detail in which the book might be improved.

It is a good thing to "give special prominence to geometrical methods," but we do not think it is sound to estimate, say, the number of tangents that can be drawn from a cusp, real or imaginary, by inspection of the figure (p. 18), especially when no discussion of the form of a curve near a real cusp has been given; the question is in its essence an algebraical one and cannot really be decided except on algebraical grounds.

A process is given (§ 2) for finding the eliminant of two binary quantics of degree  $n$ . The result would be of the degree  $2^n$  in the coefficients.

The condition given on p. 4 for the equality of  $r$  roots of an equation would lead us to conclude that the equation  $3x^4 - 4x^3 + 1 = 0$  has three equal roots.

In the proof of Plücker's equations (chap. iv.) it is only shown that  $m$  cannot exceed  $n(n-1) - 2\delta - 3\kappa$ , and that  $\iota$  cannot exceed  $3n(n-2) - 6\delta - 8\kappa$ . It is not proved that the curve and the Hessian meet only at multiple points and points of inflexion.

On p. 62 it is proved that the node of a nodal cubic is a pole of the line of inflexions. The author must have forgotten for the moment that the node is a pole of any line whatever in the plane.

Cayley's theory of conjugate poles on the Hessian of a cubic is treated by means of trilinear coordinates; the figure on p. 70 does not altogether correspond with the text, for it is proved that  $K$  lies on the line  $PQ$  and that  $C(AMBK)$  is a harmonic pencil. Also it is surely wrong to say that when "A is given, there are in general three conjugate poles corresponding to A" (p. 71).

The proof (p. 115) that a quartic cannot have more than eight real points of inflexion is very flimsy; it consists of an appeal to an extreme limiting case.

The assumption that a ternary quartic can be put in the form  $lU^2 + mV^2 + nW^2$  is justified by counting the constants (p. 117), although later (p. 240) the reader is very rightly warned "that counting the constants is not always a safe process."

On p. 122 we have the theorem:—

"A conic can be drawn through the eight points of contact of any four double tangents to a quartic." It is well known that this is not true, and it is, in fact, inconsistent with the theorem at the foot of the same page.

There are some other points on which we do not agree with the author, but notwithstanding its drawbacks, the book contains much that is interesting and important.